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17" Prototype Full-Color Ferroelectric Liquid Crystal Display.

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Introduction

Surface stabilized ferroelectric liquid crystal display (SSFLCD)[1] has attracted great interest because of their wide viewing angle, fast response time and high contrast ratio. Especially τ-Vmin mode is promising because it can realize both fast response time and high contrast ratio with C2 alignment state[2),3)]. A 17" prototype full color ferroelectric liquid crystal display (FLCD) with 720 x 916 dots using τ-Vmin mode was developed[4),5)]. Combining 2bit spatial dither (SD) and 4bit temporal dither (TD), 256 gray levels (8bit) was achieved. Response speed of FLC materials is about 12μs/line which is fast enough for 4bit TD[5),6)]. The FLCD shows high contrast ratio of 1:150, wide viewing angle and high shock stability of 20kg/cm^2 due to spacer wall structure[4)]. In this presentation, some techniques used in the prototype are shown[5)].

Materials and Alignment

FLC material SF-2692[5)] showing minimum in its τ-V plot was used. This material shows fast τmin value (9μsec) and reasonable Vmin value (28V) at 25℃. In a parallel rubbing cell structure with a pretilt angle of 3-5° , the material shows C2 alignment state. Using the τ-Vmin mode material, C2 state shows larger memory angle under bias voltage.

Device Structure

The panel structure is a simple passive matrix type with no active elements. On both glass substrates with electrodes, a barrier layer and a middle pretilt polyimide aligning film were coated. One substrate has a color filter with R,G,B sub-pixels. An aligning film was rubbed in a parallel direction, which gives 100% C2 uniform state. Each pixel was divided into two areas by 1:2 ratio for spatial dither[4),5)]. Polymer spacer walls were built in FLCD for controlling the cell spacing and giving high shock stability of 20kg/cm^2 [4),5)]. The cell spacing was about 1.4μm.

Grey Scale and Addressing

One of the biggest problems in FLCD is difficulty of achieving grey scale. In the prototype FLCD, we have achieved 256 grey levels by combining 2bits spatial dither (SD) and 4bits temporal dither (TD)[4).5)]. Each pixel was divided into two sub pixels by 1:2 ratio, which realize 4 gray levels as shown in Fig. 1. Using fast response time of the FLC material, 4bits TD with 1:4:16:64 ratio is also applied. Example of optical response in 4bits TD operation is shown in Fig. 2[7)]. In this case, duty ratio is 1/360 and line addressing time is about 12μs/line. DRAMA3(110)[8)] driving scheme was applied.

Prototype 17" FLCD

A 17" video rate full color FLCD was fabricated integrating the above-mentioned technologies. The specification of the panel[4),5)] is shown in Table 2.

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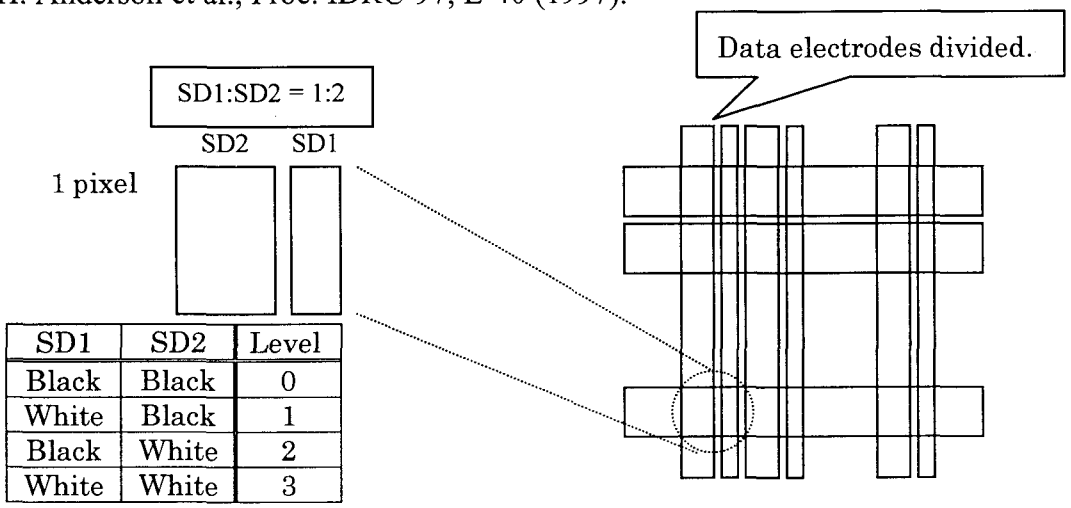

SD1	SD2	Level
Black	Black	0
White	Black	1
Black	White	2
White	White	3

Fig. 1 Schematic diagram of 2bits SD.

Table 1 Specification of the prototype FLCD.

Display Size	17-in.
Pixel Number	916x720(x3)
Orientation State	C2Uniform
Duty Ratio	1/360 (60Hz Interlace)
Line Address Time	12μs/line
Gray Scale	256 gray levels
Colors	16,700,000 colors
Contrast Ratio	1:150
Brightness	200 cd/m^2
Shock Stability	20 kg/cm^2

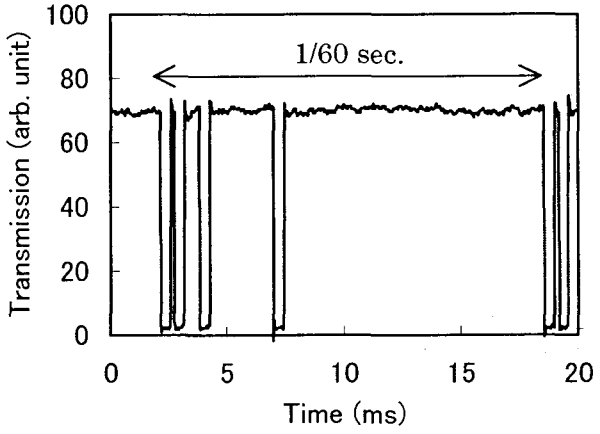

Fig.2 Optical response in 4bits TD operation.